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GEOLOGY OF A PORTION OF FABRE TOWNSHIP

PONTIAC COUNTY

By ROBERT HARVIE, Jr., M. Sc.

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TABLE OF CONTENTS

Introduction 5
Bibliography 7
Character of the District..... 7
General Geology 8
Table of Formations..... 10
Keewatin 10
Keewatin Diabase 11
Granodiorite 12
Unclassified Keewatin 12
Laurentian 13
Fabre Series 15
Cobalt Series 17
Lorrain Series 19
Newer Diabase and Gabbro..... 20
Correlation with other Districts 25
Economic Geology 28
Conclusions 31
Clays 32
Water Resources 32

To MR. THEO. C. DENIS,

SUPERINTENDENT OF MINES,

QUEBEC, P. Q.

Sir:—

I beg to transmit herewith my report on the geology of a portion of Fabre Township, resulting from the field-work done by your instructions during the Summer of 1910.

Yours truly,

ROBERT HARVIE, Jr.

GEOLOGY OF A PORTION OF

FABRE TOWNSHIP, QUEBEC

BY

ROBERT HARVIE, Jr., M. Sc.

INTRODUCTION.

General Statement and Acknowledgments: During the great activity in prospecting following the discovery of the valuable deposits of silver at Cobalt the attention of a considerable number of prospectors was attracted to the township of Fabre, where it was soon shown that there also were occurrences of rocks similar to those at Cobalt. Their work being hampered by lack of a satisfactory geological map, the writer was instructed by the Quebec Department of Mines to revise the previous information and to prepare a new detailed map and report. Two months and a half were spent in the field in the summer of 1910, during which time a careful micrometer and compass survey was made of the rock exposures in the portion of the township found to be the most favourable for prospecting. Since previous work in other districts had shown that the silver-bearing ores are closely associated with the "newer diabase," the area covered by detailed work was confined to the vicinity of the occurrences of the diabase, so that for some small portions of the map the information has been used unrevised from the work of the Geological Survey of Canada. Thus the revision was not continued into the large area of Laurentian granite and gneiss lying to the south and east, and the geology of ranges I-IV, north of Young's Creek on map sheet No. 1066 of the Geological Survey of Canada, as given by M. E. Wilson, was accepted, though with slightly modified boundaries. The area of the portion revised is between forty-five and fifty square miles.

The surveying was carried on in an intelligent and enthusiastic manner by Messrs. F. B. Painchaud and O. R. Pépin, students of l'Ecole Polytechnique, Montreal, to both of whom I am indebted for highly efficient service. Acknowledgments for favours and assistance received in the course of the work are especially due to Messrs. T. Drolet, Wm. Donohoe, Jas. Mitchell and Andrew Stewart of Fabre. In the preparation of this report

I have been aided by the friendly criticism of Prof. C. K. Leith, of the University of Wisconsin, and Dr. W. H. Collins, of the Geological Survey of Canada.

Location: Fabre Township is situated on the east side of Lake Temiskaming, which here forms the interprovincial boundary between Quebec and Ontario. Fabre Wharf is thirty-eight miles from Temiskaming station, on the Mattawa branch of the Canadian Pacific Railway, at the outlet or south end of Lake Temiskaming; or twenty miles from Haileybury on the Temiskaming and Northern Ontario Railway at the head or north end of the lake. There is a good service of steamboats between these points. The accompanying key plan shows the relative position of the area.

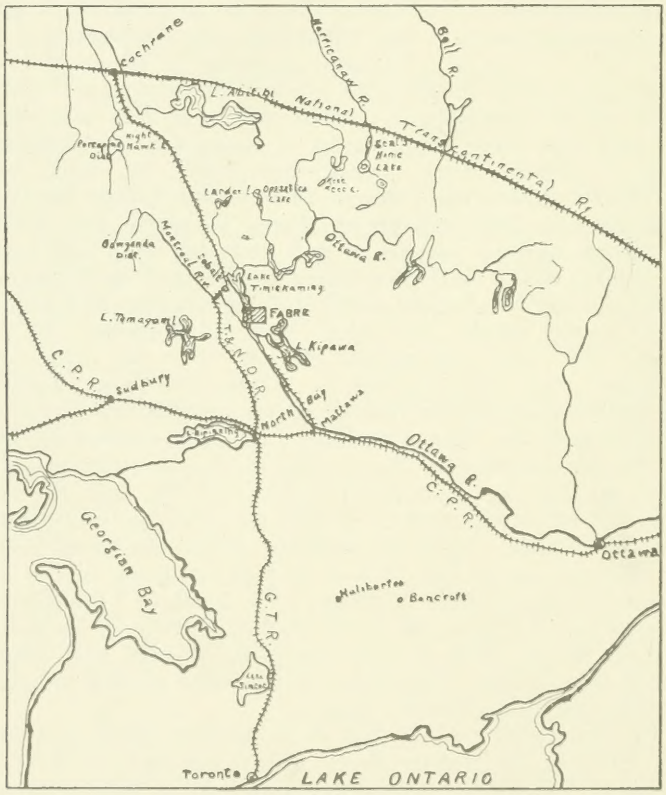

FIG. I.

Key plan showing the relative position of Fabre and the other districts referred to in this report.

Previous Work: Sir Wm. Logan and other early explorers have made brief reference to the geology of the shores of Lake Temiskaming. A slightly more general account is found in the report on the Lake Temiskaming sheet by Dr. A. E. Barlow. A further report by M. E. Wilson, of the Geological Survey of Canada, has just been published, a preliminary edition of the map to accompany which having already been issued as No. 1007. The same information revised has been included in map No. 1066. The larger scale and greater detail employed in the present work have resulted in changing a good deal of the previous mapping, but the main conclusions are confirmed.

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- Wilson, M. E. Summary Report 1907, p. 59.
- Wilson, M. E. Report 1064, 1911, with maps 1007 and 1066.

For the Ontario side of Lake Temiskaming see: Burrows, A. G., on South Lorrain,—Ontario Bureau of Mines, Annual Report, 1908, pt. II.

GENERAL CHARACTER OF THE DISTRICT.

The surface features of Fabre Township are described briefly as consisting of a series of clay flats, out of which arise at intervals steep rocky hills. On the shores of Lake Temiskaming the flats are not greatly above the level of the water, but going inland they rise in broad steps until they reach the area of granitic rocks, where the distances between the hills becoming less, the intervening flats die out. The hills, both on the lake shore and inland, attain a somewhat uniform height, so that the rise in level of the clay flats, while allowing great relief and high hills on the shore, inland reduces the relief and apparent height of the hills by girdling them at successively higher levels. In general there is a sharp line of division between the clay flats where no rocks are exposed, and the hills where good rock exposures are found. Since the clay areas and rock areas have been distinguished separately, the map will be found quite as useful to the settler in indicating the portions suitable for cultivation, as it will be to the prospector in indicating the portions favourable for his work.

The soil of the clay areas is found to be very fertile and already a considerable portion of the township has been taken up by settlers. In most cases the land is very readily cleared and

brought under cultivation, owing to the successive forest fires having removed the original heavy growth of timber, while the second growth has not yet reached any great size and is easily removed.

The two streams, Lavallee and Young's creeks, with their tributaries, give Fabre Township a good drainage system. The relations of relief, slope, etc., are such as to give a good run off to all parts of the area, and it can be said that there are no swamps or muskegs.

GENERAL GEOLOGY.

Introduction: The Fabre map sheet just touches the northwestern fringe of the immense area of Laurentian rocks that occupies almost the whole of that part of Canada lying in the Province of Quebec north of the St. Lawrence River. The strip of Laurentian shown as continuous on the south and east sides of the sheet, thus only represents the margin of a very extensive area of these rocks. To the west and north for a distance of a hundred miles or more, the Huronian and Keewatin rocks predominate, but with occasional areas of Laurentian. On a small scale the same relations are found within the area of Fabre. To the southeast the Laurentian is alone present. Going northwest first a belt of dominantly Keewatin is found, with occasional small areas of Laurentian, next a belt of Huronian with small patches of Keewatin, and finally in the northwest corner, Huronian rocks alone.

The geological sequence of Fabre is very similar to that of the Cobalt district described by W. G. Miller,* but is fuller, since another Huronian series is present, not known at Cobalt. Briefly, a thickness of approximately 750 feet of slighly disturbed Huronian sediments is found resting on an uneven surface of Keewatin and Laurentian igneous rocks. Subsequent to the deposition of the Huronian there has been an intrusion of diabase in dykes and sills. In the long interval which has elapsed since this intrusion, extensive erosion has produced the present irregular surface of the bed-rock topography, the valleys of which are now partly filled by the clay flats which are a notable feature of the district.

Keewatin: The oldest series in the district, the Keewatin, consists of greenstone schists, granodiorite and diabase. In general these rocks have been squeezed, and in some cases it is very difficult to tell what was the original character of what are now schists.

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*Ontario Bureau of Mines, Annual Report, 1905, pt. II.

Laurentian: The various types of Keewatin rocks have been intruded by a granite with its accompanying dykes of granite-porphyry, aplite, etc. The mechanical movements connected with this intrusion have probably been largely responsible for the squeezing of the Keewatin rocks above mentioned. None of the granite rocks intrude the rocks of the Cobalt series.

Following the Keewatin and Laurentian is a succession of sediments assigned to the Huronian and represented by three series:—the Fabre, Cobalt and Lorrain.

Fabre Series: Closely associated with the Keewatin, and also somewhat squeezed, is a thin succession of conglomerate, arkose, quartzite and greywacke, which represent the lowest series of Huronian found in the district. This series lies below, and is essentially different from the Lower Huronian described by Miller at Cobalt, and also well developed in Fabre. The relations to the Laurentian are less well known, the sediments being older than some of the dyke-rocks and younger than others.

Cobalt Series: Laid down on a very uneven floor, is the series of coarse rounded conglomerate overlaid by greywacke, slate and arkose, the extension of the series called by Miller the Cobalt series, and by him referred to the Lower Huronian. In Fabre a dense greenish greywacke of the Fabre series is found beneath the conglomerate with a distinct erosion contact.

Lorrain Series: The reddish arkose of the Cobalt series passes upwards with slight (if any) unconformity into the greenish more or less felspathic quartzites known as the Lorrain series. In the Gowganda district the evidence of unconformity is considered to be sufficient, though not superabundant.

In Fabre the transition is generally marked by thin beds of an angular conglomerate repeated at frequent intervals in the quartzite. An angular conglomerate grading upward into an entirely similar greenish quartzite found in several places, has been mapped as lying between the Lorrain quartzite and the Cobalt series.

Post-Huronian Diabase: In intrusive contact with all the above mentioned series is the diabase so well known as being the source of the silver ores of the Cobalt and neighbouring districts.

TABLE OF FORMATIONS IN FABRE.

PLEISTOCENE.

Glacial and recent..... Clays, sands and gravel.

(Very great unconformity.)

PRE-CAMBRIAN.

Post-Huronian..... Newer diabase and gabbro.

(Igneous contact.)

Huronian:

Lorrain Series..... (a) Arkose and quartzite, up to 400 feet thick.
(b) Angular conglomerate, up to 30 feet.

(Slight, if any, unconformity.)

Cobalt Series. (a) Arkose, greywacke and slates, up to 335 feet thick.
(b) Rounded conglomerate, up to 50 feet thick.

(Distinct unconformity.)

Fabre Series. Comprising all sediments older than the Cobalt series.
(a) Greywacke and graphitic schist up to 10 feet thick.
(b) Schistose quartzite, up to 100 feet thick.
(c) Recrystallized arkose, amount unknown.
(d) Schistose conglomerate, up to 200 feet thick.

(Unconformity.)

Laurentian..... Granite and allied rocks, known to be of several ages, but not yet sub-divided, being partly older, partly younger than the Fabre series.

(Igneous contact.)

Keewatin..... Granodiorite, intruding the diabase; ~~diorite~~ diabase apparently the basement rock; schists of various origins and ages, unclassified.

KEEWATIN.

The name Keewatin is here applied to a rather complex group of igneous rocks, all of which have been disturbed and more or less metamorphosed. They form a unit in comprising all the rocks older than the intrusion of the granite and compose the basement or oldest series of the district.

In a general way the Keewatin is found as a belt following the margin of the large granitic area of which the western boundary comes within the map sheet. However, the relief produced by erosion is sufficient to cut through the Post-Keewatin sediments and show occasional exposures of Keewatin rocks some distance away from this margin.

The Keewatin rocks show a considerable degree of metamorphism, at least a large part of which appears to be due to the effects of the granite intrusion. The district is rather small to show it conclusively, but as has been noted in other districts, the rule holds here that the Keewatin rocks show increasing metamorphism with approach to the granite, and that there is commonly a contact zone of schists.

The principal types of Keewatin rocks found in Fabre are diabase, granodiorite and schistose derivatives of these,—hornblende, chloritic, and other schists. The diabase is frequently intruded by the granodiorite and is thus the older.

Keewatin Diabase.

The more important areas occupied by the diabase are found in the district comprised by lots 20-27 of IV. and the western portion of V. S. and VI. S. Another occurrence is on lots 7 and 8 VII. N.

In the hand specimen the diabase is very dark green to black, usually rather coarsely crystalline, but showing only a few signs of diabasic structure since the decomposition of both ferromagnesian minerals and felspar has generally gone so far as to mask the structure.

Thin sections show that in every case the diabase is very much decomposed, but sufficient evidence is still left to identify the original rock as a typical diabase. The original augite is represented by hornblende. The felspars have gone to secondary albite, zoisite, epidote and calcite. Leucoxene has been formed probably from titanite. The original ophitic structure is still distinctly recognizable.

Metamorphism has produced relatively little effect on the diabase, apparently largely owing to the fact that the secondary hornblende of which it is mainly composed is one of the common products of metamorphism.

In several places, notably on lot 7 of VII. N., also 5 of V. S. the altered porphyritic variety of diabase known as Huronite is found. On lots 7, 8 and 9, of V. S. the diabase contains very large amounts of magnetite, so much so that on lot 9 a prospect pit has been opened, apparently to test it as an iron ore. Here the magnetite has a considerable amount of pyrite associated with it, and these two compose over three-quarters of some portions of the rock. In other places an acid differentiate of the diabase is found. Near the south boundary of lot 9 of V. S. the rock is very coarse-grained, showing secondary hornblende up to an inch across, in poikilitic intergrowth with saussuritized felspars. In a number of instances grains of pyrite and galena were noted, forming the core of the hornblende. Small amounts of galena are also found in fissures in the rock. A similar variety of the diabase also containing small veins of galena is found on lots 24 to 26 of IV.

The Keewatin diabase is believed to be the oldest formation of the district. It is not found intruding any other rock, but is itself intruded by all the other igneous rocks and furnishes fragments to the Huronian.

Granodiorite.

The granodiorite is the most important Keewatin rock, and is found in numerous widely distributed outcrops. In hand specimens the granodiorite varies from an olive green to a greenish black colour, showing blue eyes of quartz. The texture is fine-grained, and on closer examination granitic, although at first sight the quartz eyes give a porphyritic appearance. These quartz grains are very useful in identifying this rock, since even when the rock is squeezed or decomposed they remain prominent, and afford an easily recognizable characteristic.

Thin sections show the granodiorite to be composed essentially of hornblende, felspar and quartz. The hornblende is a pale green, slightly pleochroic variety, having good outlines. The felspar shows good forms having a zonal structure, the rims being better preserved than the cores, which are in large part decomposed, some individuals having gone to sericite, others to epidote and zoisite. A number of the rims and some complete individuals were determined as albite. On account of difference in decomposition and other characters of the residues, it is considered that orthoclase felspar was also originally present. Felspar composes probably over one-half the rock. Quartz varies in amount, but is generally abundant, in large patches in the interstices of the other minerals. Titanite, secondary chlorite and calcite were also observed. The texture is holocrystalline, even-granular, coarse granitoid. The rock has been given the name granodiorite as best describing what is believed to be its original composition.

Owing perhaps chiefly to the large amount of felspars and ferromagnesian minerals, the granodiorite readily undergoes decomposition. Where this has taken place the result has been to produce a mass of sericite, chlorite, zoisite, epidote and calcite, scattered through which are the unaltered grains of quartz. As has already been mentioned, this gives on casual observation the effect of a quartz porphyry, and the rock has been so named, in some of the previous reports. The confusion has been added to by the fact that large areas of quartz porphyries do occur in the township north of Fabre, but so far as known, not in Fabre itself. The distinction is, after all, a matter of the grain of the rock, the quartz porphyry being the porphyritic surface equivalent of the even-granular, coarser-grained granodiorite.

Unclassified Keewatin.

It was found possible to distinguish approximately three-quarters of the total area of Keewatin as either diabase or granodiorite, but the remaining quarter has been left undivided, although by careful work probably most of it could be similarly divided. As at present mapped this unclassified portion includes

both complex diabase and granodiorite areas and also small amounts of other varieties of rocks, such as hornblende, greenstone and other schists, and ellipsoidal greenstones.

Complex Areas: The area of Keewatin rocks on lots 2-6 of V. S. includes two portions which were found to be too complex to subdivide. A large part consists of granodiorite, which, with very detailed work, might possibly be mapped separately. On the northern half of the area there are a number of east-west bands of typical ellipsoidal greenstones, associated with dense fine-grained greenstones.

An area somewhat similar to this last is found crossing lots 11-13 of V. S. and 13-15 of V. N.

Schists: In a number of places the Keewatin rocks have been metamorphosed into schists and have lost so much of their original features as to render it difficult to work out their origin.

On lots 18-19 of IV. there is a small area of fine-grained hornblende schist in intricate relation with a more acid variety of rock. These were probably originally diabase and granodiorite.

On lot 44 of IV., below the mill, the newer diabase cuts a fine-grained greenstone schist containing drawn out lenticular cavities lined with epidote and filled with calcite. Nothing can be said about the source of the schist, further than that thin sections show features distinctive of an igneous rock.

The area of green schists on lots 7-10 of VII. N. appears to have been derived from a diabase. At present it is highly chloritic, with calcite in forms suggesting former labradorite laths.

The Keewatin rocks have been grouped together chiefly on the grounds of forming that part of the basement complex older than the granite intrusion. The detailed evidence of some of the relations of the various types of rocks will be found tabulated at the end of the section on the Laurentian. It will be seen that this evidence, supported by other general field observations, is sufficient to demonstrate the relations of most of the types.

LAURENTIAN.

The Fabre map-sheet just touches the northwestern fringe of the immense area of Laurentian rocks that occupies almost the whole of that part of Canada lying to the east of Fabre, north of the St. Lawrence River. Since the purpose of the work was specially the investigation of the extent and economic possibilities of the Post-Huronian diabase, examination was not made of the main Laurentian area farther than to confirm the absence of diabase. The strip of Laurentian rocks shown as continuous on the south and east sides of the sheet thus only represents the margin of a very extensive area of these rocks. Not far outside the map-sheet a gneiss is found, but none is known to occur in

the part mapped. The work of Wilson, over a much larger area, shows that except for one instance no evidence of more than one intrusion of granite or gneiss can be found. In the instance referred to, of two occurrences of what he considers to be the same sediments, in one case the sediments are intruded by granite, in the other they are younger than the granite. This he interprets as signifying that there are two different granites. In the present report it is held rather that the granites are the same but the sediments differ.

The granite is the usual even-granular holocrystalline coarse granitoid rock typical of the name. It is commonly of a greenish or greyish colour, less often pink.

Thin sections show the granite to be composed of dominant albite, with subordinate orthoclase, epidote, and chlorite apparently resulting from hornblende, also quartz and accessory apatite. No traces of the original hornblende were found, and the felspars also were much decomposed.

A large number of dyke rocks of the granitic class were found, the following varieties being noted,—biotite, and hornblende granite porphyries; muscovite granite pegmatite; hornblende syenite porphyry. Of these the syenite porphyry dykes are much the more abundant. The relative age as established by intersections was found to be, granite the oldest, followed by hornblende syenite porphyry, followed by biotite granite porphyry.

In South Lorrain a considerable area is found of a hornblende syenite closely similar to the dykes of Fabre. It also is younger than the Keewatin, and may be the source of these dykes.

The granite and its allied dyke-rocks are found to be younger than the rocks classed as Keewatin. The evidence is quite clear that the granitic rocks are all older than the undoubted Cobalt series. The Fabre series, however, occupies an intermediate position, fragments of syenite porphyry are found in the conglomerate, but later granite porphyry dykes cut the graphitic schists. The following table shows the relations from which the order of age of the Keewatin and Laurentian rocks was obtained, the figures showing the number of occurrences observed.

CUT BY	ROCK CUT.							
	Diabase	Granodiorite	Green schist	Hornblende schist	Granite	Syenite porphyry	Graphitic schist	Granite porphyry
Diabase	0	0	0	0	0	0	0	0
Granodiorite	3	0	0	0	0	0	0	0
Granite	2	2	1	1	0	0	0	0
Syenite porphyry	5	1	1	1	1		0	0
Granite porphyry	2	1	0	0	1	1	2	0

FABRE SERIES.

Fabre series is the name here proposed for a group of sedimentary formations lying unconformably beneath the Cobalt series. The occurrences, so far as known, are rather scattered, and there is still some uncertainty as to the exact sequence and relations of the members of the series, nevertheless it is believed that the succession is as it has already been given in the table of formations. Further it will be shown in the section on correlation that there is reason to believe that this series is probably represented in other districts, especially to the north and northeast in Ontario and Quebec.

Descriptions of Occurrences

Striking nearly east and west across the middle of the Keewatin complex found on lots 2 to 5 of Range V. South, is a band of rather squeezed conglomerate. The foliation is parallel to the strike and dips to the north at 65°, being similar to that of the neighbouring schists. In places it attains a width of 325 feet. On lot 3 the conglomerate has been faulted with a horizontal displacement of 100 feet.

The paste cementing the fragments is dark greenish, very fine-grained chloritic material, contains small angular grains of quartz and recrystallized felspar, and was apparently deposited as a mud. The inclusions noted were syenite porphyry, granodiorite, quartz with hematite, and magnetite such as is found as basic segregations in the Keewatin diabase. The most abundant fragments are of the granodiorite, with which the conglomerate is in contact. On lot 2 a band of somewhat recrystallized arkose is associated with the conglomerate. The relations of the conglomerate to the adjacent Keewatin rocks are not clearly shown. Since, however, it contains fragments of both Keewatin and Laurentian rocks, and is thus clearly younger than the rocks with which it is in contact on both sides, it would seem to be either infolded or faulted.

On the west front of the hill, running diagonally across lots 13-15 of Range V. North, there is a similar though much squeezed conglomerate. On lots 15, ranges V. and VI. North, a schistose quartzite and greywacke occur apparently associated with this conglomerate, and since they are on the main Huronian side of the Keewatin, presumably lie on top of it. On lot 13, range VI. N., beside the upper dam on Young's Creek, a few chains west of this last locality, there is a small exposure of greywacke which is probably the lateral extension of that just mentioned. The greywacke is fine-grained, somewhat banded and composed chiefly of angular grains of quartz with lesser amounts of felspar, sericite, chlorite, and iron ore. The greywacke is overlain by the Cobalt conglomerate, which has both a distinctly unconformable dip and also contains pebbles of greywacke.

Another good exposure of presumably this same greywacke is found on the shore of Lavallée Bay, near the mouth of Lavallée Creek. Here the Cobalt conglomerate rests unconformably on a fine-grained greenish greywacke, composed chiefly of minute angular quartz fragments with a few grains of felspar, also sericite, chlorite and some very fine material. There is no great unconformity between the dips of the greywacke and the conglomerate, but the greywacke has a distinct eroded surface. This was very clearly seen, places being observed where blocks in the top layer had been plucked off, leaving a step in the surface. The conglomerate did not receive many fragments from the greywacke, but a few were noted near the contact. There is considerable diversity in both amount and direction of dip in greywacke, opposite dips of 10° occurring within a distance of ten chains.

Two small occurrences of graphitic schist, probably part of one of larger area, were found in range VIII. N. That on lots 2 and 3 consists of a fissile highly graphitic schist extremely folded and with few traces of its original character. Quartz is the most abundant mineral, occurring in drawn out groups, also in isolated angular grains, as if possibly of clastic origin. A sericitic material and graphite together form a mat enclosing the quartz, and also less abundant minerals as felspar and pyrite. This occurrence is cut by a granite porphyry dyke and overlaid by a slightly recrystallized arkose.

The second occurrence is on lot 1, beside the dam on Young's Creek. It is a somewhat recrystallized fine-grained banded schistose greywacke, containing large irregularly distributed angular quartz and felspar grains. The layers are marked off by streaks of opaque black material, probably graphite. It is also cut by a granite porphyry dyke, but shows no other relations to other rocks.

Two occurrences of sediments similar to those of the Fabre series are found in the next township to the northeast of Fabre, and have been described by Wilson.*

About three miles northeast of the northeast corner of the Fabre map-sheet, "a contact was observed about two and a half miles southwest of Otter Lake, where the granite is intruded into the Huronian. The Huronian is represented at the point of juncture by greywacke, large masses of which are included in the granite in the vicinity of the contact. The dividing line between the two rocks is fairly definite, the granite sending off small stringers into the greywacke along its margin."

Some five miles further to the northeast, "in the Lac Clair district, there are a number of elongated patches of conglomerate, included in the Keewatin, and which contain pebbles of greenstone and banded iron, evidently derived from the

*Wilson, M. E., Geology of an Area adjoining the east side of Lake Temiskaming, pp. 18 and 20, Geological Survey of Canada, No. 1064, 1910.

surrounding rocks. The exact geological position of these conglomerates is not at all apparent, though it would seem probable that they represent remnants of the basal member of the Huronian, which at one time overlay the greenstone."

"There are some quartzite rocks included in the Keewatin greenstones which may possibly be of sedimentary origin. Examples of this occur a short distance south of the Head rapids on Riviere des Quinze, and on the south shore of the same river below the Cypress rapids."

In South Lorrain, on the west side of Lake Temiskaming, across from Fabre, a greywacke underlying the Cobalt conglomerate, and similar to that of the Fabre series, has been noted by Burrows.*

To sum up, it is found that unconformably below the basal conglomerate of the Cobalt series, and younger than at least some of the Laurentian dyke rocks, there is a schistose conglomerate with some arkose, schistose quartzite, greywacke and graphitic schists, but it is not known definitely whether this is the complete succession or even the proper sequence of these rocks. The unconformity of the Fabre series to the Cobalt series is shown by,—(a) difference of attitudes; (b) actual erosion contact with the overlying basal Cobalt conglomerate; (c) relative much greater deformation of the Fabre series; (d) possible intrusion by granitic dykes in one case and not in the other.

As will be mentioned again, an arkose pebble containing fragments of a sedimentary rock found in the Cobalt conglomerate gives evidence of two unconformities below the Cobalt conglomerate. Considering the contact of the conglomerate with the underlying greywacke as being one unconformity, then there must be still older sediments lying unconformably beneath the greywacke.

COBALT SERIES.

Areal mapping about Lake Temiskaming has shown that the two series called by Miller the Cobalt and Lorrain series, extend into Fabre, and these names are therefore retained in the present report.

The Cobalt series, consisting of a coarse rounded conglomerate overlain by greywacke, slate and arkose, is chiefly distributed in the northwest portion of Fabre. Just outside the township, to the north, still larger areas are found. Numerous small areas are found scattered through the central part of the map-sheet, but since they are generally more or less isolated and give no great vertical section, little was learned from them. For the portion of the map revised by the writer, the conglomerate has been separated from the greywacke, slate and arkose, but this

*Burrows, A. G., Ontario Bureau of Mines, 18th Annual Rept., pt. II., p. 24.

has not been done in the remaining portion of Fabre or in South Lorrain.

The best section of the Cobalt series is found on the shore of Lake Temiskaming, south of Lavallée Bay. Here a thickness of from three to ten feet of conglomerate is found lying on an eroded surface of the dense greywacke of the Fabre series mentioned above. The conglomerate is made up of generally very well rounded fragments varying in size from eight inches across down to fine sand. Among the inclusions were noted hornblende, biotite and muscovite granites as the most common; next granite-porphyry and similar dyke rocks, then granodiorite, various undetermined greenstones, a number of the underlying greywacke, and lastly one of arkose. The arkose pebble is noteworthy because it is partly made up of fragments of a still older greywacke or arkose. This means that somewhere a greywacke or arkose was deposited which, after solidification and a change of conditions, was acted on by erosion. The resulting detritus was, after a time, solidified, probably forming part of the Fabre series. This new formation in turn was also subjected to erosion, and the detritus containing fragments which themselves hold remnants of this still older detritus, has formed the conglomerate and other deposits of the Cobalt series. This one pebble by itself alone gives evidence of two erosion unconformities. Considering the underlying greywacke as giving one unconformity, then this pebble goes to show that there must be still older sediments lying somewhere unconformably beneath the greywacke.

Seemingly sedimentary pebbles were found in the conglomerate at Cobalt, but they were considered by Miller* to be of igneous origin, since older sediments were not known to occur.

The matrix of the conglomerate varies, from dominantly a fine-grained dark-green chloritic material to an arkose with a small amount of dark material. In general the conglomerate gives a dark colour effect. A very striking feature is the fact that in places the conglomerate may be described as a greywacke containing occasional large pebbles, which peculiarity has earned for it the name of "slate" conglomerate, used by the earlier geologists.

Going upwards by a gradual and even sudden diminution in the number of pebbles, the conglomerate passes into an arkose. The arkose is fine grained and varies from a greenish gray colour to a pinkish gray. The beds are from six or eight inches to three feet in thickness, and commonly have a clayey parting. On a thickness of over 135 feet of this arkose rests a band, one foot thick, of a purple slate. The slate is composed of very fine angular grains of quartz and felspar with plates of sericite and chlorite in parallel arrangement. The slaty cleavage is very imperfect. Above the slate there is sixty-five feet of arkose similar to that below, but this is followed by 130 feet of

*Ontario Bureau Mines, 18th Annual Report, pt. II, pp. 48-49.

coarse heavy-bedded pinkish arkose, containing occasional thin conglomerate bands, and forming the top of the hill. This section thus shows a thickness of 330 feet of these sediments.

About one mile south of Lavallée Creek a small exposure on the shore shows the southern margin of the conglomerate resting on coarse Laurentian granite. A very striking feature is the presence in the conglomerate of a number of granite and greenstone boulders up to three feet across.

In the areas found in the northern part, the conglomerate attains a much greater thickness, even up to fifty feet. Jasper and other iron range pebbles are also more common to the north, though nowhere very abundant. Arkose fragments were noted in the conglomerate on lot 8 of VIII. N., also 10 and 13 of VI. N.

On lots 10 and 11 of range VI. N. the conglomerate overlies an arkose similar to that usually found above the conglomerate. This was interpreted as being a repetition of the conglomerate, the lower beds being probably represented by the exposure about fifteen chains to the north, which shows the proper dip and strike for that position.

The Cobalt series is found resting unconformably on various Laurentian and Keewatin rocks, also greywacke of the Fabre series. Between the Cobalt series and that next younger, the Lorrain series, there is little, if any, unconformity in Fabre. In the Cobalt and Gowganda districts there is believed to be an unconformity.

LORRAIN SERIES.

This series consists almost entirely of quartzite, but with a small amount of conglomerate, lying with slight if any unconformity on the arkose of the Cobalt series. The sequence is shown in the occurrences on lots 36 and 37, also 43 to 46 of Range II. Going upwards the pinkish arkose of the Cobalt series changes rather suddenly to the yellowish green felspathic quartzite of the Lorrain, the transition being marked by rather numerous slightly conglomeratic bands. The pebbles of these bands are remarkable in being for the most part angular quartz, with occasional jasper fragments. The section on lot 45 of Range II gives 400 feet as a partial thickness for the quartzite.

On lots 1 to 6 of Range V. S., the Keewatin area has lying on it in several places, a conglomerate which rapidly grades upwards into a greenish quartzite, of exactly similar character to that just described. The conglomerate consists wholly of angular material, chiefly derived from the adjacent underlying rocks. The upper portion of the Keewatin has been broken into large angular blocks as much as five feet across, which, having had the interspaces filled with the quartz sand, now form the lowest portion of the conglomerate. Going upwards the angular fragments diminish in size till about fifty feet above

the base they are entirely lacking, and the conglomerate grades over to a quartzite. On lots 7 and 8 of V. N. the extension of the conglomerate overlies a dark coloured arkose or greywacke. Considering the very strong similarity of the quartzite and, to a less degree, the angular nature of the conglomerate, it is believed that these occurrences belong to the Lorrain series..

A somewhat comparable occurrence, near Ville-Marie, not far to the north of Fabre, has been described by Barlow.* There the typical quartzite is found to be derived from the decomposition of a granite in place.

On lot 7, Range V. N., the angular conglomerate, similar to this last, is found lying on top of an arkose. Another occurrence is on lot 35, Range IV.

NEWER DIABASE AND GABBRO.

The "newer" diabase is so called in distinction to the older Keewatin diabase. The name gabbro has been applied to the very coarse phases of diabase, but since the ophitic texture is also shown by these coarse varieties, this is an improper use of the term gabbro. Nevertheless since the term is in common use amongst prospectors and others, it seems advisable to retain it for the present.

The newer diabase occurs in a large number of small, more or less isolated patches. Considering these in a broad way, it may be said that the diabase is distributed in two belts, one roughly paralleling the contact between the Huronian and the older rocks, running diagonally across ranges II., III., IV., V. S., and V. N., the other following the shore of Lake Temiskaming and occupying the points between Fabre wharf and Baie de l'Africain.

The petrographic study of the diabase rocks confirmed the general facts brought out by more detailed studies of geologists in other neighbouring districts**

In hand specimens the diabase varies from a fine-grained greenish black rock, showing a ferromagnesian mineral penetrated by laths of a greenish yellow felspar, to a very coarse-grained reddish rock showing a network of ferromagnesian individuals in a background of dark reddish felspars.

In thin sections it is found that the diabase is generally very much decomposed and it is only in a relatively small number of

*Geological Survey of Canada, Vol. X, 1897, p. 195, I.

**Details of the petrography of the diabase may be found in the following articles:

Barlow, A. E., Journal of the Canadian Mining Institute, XI, 1908.
Bowen, N. L., Journal of the Canadian Mining Institute, XII, 1909.
Journal of Geology, Vol. XVIII, 1910, p. 658.
Collins, W. H., Economic Geology, Vol. V, 1910, p. 538.
Hore, R. E., Canadian Mining Journal, April 15th, 1909.
Economic Geology, Vol. VI, p. 51.

slides that the original minerals remain sufficiently fresh to be recognized.

The fresh medium-grained rock is composed chiefly of equal amounts of large augites, and felspars which penetrate the augite. In lesser quantity is quartz, chiefly intergrown with felspar. Apatite, titanite, magnetite and pyrite are found as accessories. The felspar was found to be a basic labradorite.

The coarse variety, commonly known as "gabbro," and sometimes "red rock," is similar in mineral composition to the medium-grained rock, but contains a smaller proportion of augite, and further, quartz is more abundant. In a number of localities it contains small vugs lined with quartz crystals and filled with calcite.

A third type of rock associated with the diabase in small amount is known as aplite. In this rock augite is entirely lacking, its place being partly taken by small amounts of biotite. The aplite consists essentially of interlocking grains of quartz and felspar.

The relations of the diabase types are well seen on lot 44 of IV. at the mill on Young's Creek. At the contact with the Keewatin, the diabase is a dense dark coloured rock; a few inches away the separate grains are readily distinguishable and laths of a greenish yellow felspar can be seen. Going still farther from the contact the grain becomes progressively coarser, with a transition into red rock, this being typically developed as close as 15 or 20 feet from the contact.

At numerous other localities similar relations were observed, though it is only infrequently that actual contacts can be seen.

On lots 21 and 22 of II., also 29 and 30 of IV., the occurrences show fine-grained diabase on the margins and lower parts and successively red rock and aplite towards the middle and higher. There seemed to be a progressive vertical gradation from fine-grained diabase below, through red rock to a typical aplite on top. Suggesting a further step or extreme limit, it was noted that the aplite of the second locality showed irregular spots of calcite similar to the vugs found in the red rock. Similar occurrences in other districts have been ascribed as due to either assimilation of overlying sediments or to differentiation of the diabase.* The writer considers that the evidence favours differentiation.

Aplite dykes are most abundant in the diabase of the occurrences on the lake shore. Generally they are fine-grained and of a bright pink colour. Some show pockets of calcite, and in nearly all, pyrite and chalcopyrite are rather abundant. The largest dyke noticed had a maximum width of 18 inches. A considerable number average six inches thick.

The relations of these types of rocks may be generalized as

*Bowen, N. L., Journal of Geology, Vol. XVIII, 1910, p. 658.
Collins, W. H., Economic Geology, Vol. V, 1910, p. 538.

follows: In small dykes and at the margins of larger masses fine grained diabase is found. Going inwards from the contact the grain becomes progressively larger; if the igneous body is sufficiently large, red rock is found, with which aplite is associated, in complementary though relatively small proportion. The aplite and red rock are differentiates of the original diabase magma. Most commonly the aplite is found in dykes cutting the diabase. In some cases the diabase has differentiated into horizontal layers, with red rock below and aplite on top. The aplite dykes are closely associated with the silver ores in the various Montreal River districts, and it is believed that the silver-bearing minerals differentiated from the diabase at the same time as the aplite, and that they were carried into the veins where they are now found, either directly by the aplite, or by the heated waters known to be also present.

Form of Intrusion: Examination of the map shows a large number of detached occurrences of diabase in ranges IV., V. S., V. N., and VI. N. In general these rise from twenty to fifty feet above the clay flat. The lower portions of the diabase are finer-grained than the upper parts, in several cases very markedly so. The nearby outcrops of the other rocks, chiefly Keewatin, also rise very little above the clay. The small outcrop of arkose in the northwest corner of 4 of VI. N. lies at a lower level than the adjacent diabase, and shows considerable recrystallisation, apparently due to heat. A ridge running across lots 7-10 of V. S., and V. N., is considerably higher than these other occurrences. The central higher portion consists of a mass of diabase, with outcrops of Keewatin and Huronian showing on either side near the foot of the slopes. The broad area of Keewatin rocks at the south end in V. S. forms a low flat-topped ridge from which the diabase rises abruptly, as if it had formerly covered the Keewatin but had been stripped back. At the south end of lot 7 of VI. N. the diabase has a vertical contact with the Huronian. This may be one wall of a dyke, but judging from the general distribution of the diabase it is believed to be merely a local intrusive crossing of the bedding.

A brief consideration of the relations just described is sufficient to indicate that these occurrences are parts of a single former unit or mass, having its major dimensions horizontal and thus suggesting that its form is either an intrusive sill or an extrusive surface flow. The chief features distinctive of these two types are,—in surface flows the rocks are glassy or at least relatively very fine-grained, usually amygdaloidal especially at the upper and lower contacts, the upper surface is usually scoriaceous; the rocks of sills are relatively coarse-grained, very rarely amygdaloidal and never scoriaceous. The evidence shows that the occurrences are at approximately the same level, probably have about the same thickness, vertical sections show

gradation down to the underlying rock, which in some cases is actually exposed. The grain of the rock, however, is commonly quite coarse and not at all glassy, amygdaloidal or scoriaceous, although it must be borne in mind that the original upper and possibly scoriaceous surface may have been removed. In favour of a sill is the fact that large masses of sediments, such as those on the lots around 25 and 37 of II., 38 of IV., and 2 of VI. N., are not only topographically higher than the diabase occurrences, but the projection of the present attitude of the bedding indicates that the diabase was formerly probably covered by the sediments. In further support of the intrusive character of the diabase is the fact that the sediments, having a much less specific gravity than the diabase, would tend to be lifted and floated by it, rather than allow it to break through and pour out on the surface as an extrusive. It will be noted in this connection that the sill appears to have been intruded chiefly into the Huronian sediments at or near the contact with the Keewatin.

It may be mentioned as an unexpected feature that only one small dyke, showing both walls, was found cutting the sediments. This occurs on lot 1 of VI. S.

The occurrences on the lake shore form what are really quite low knobs, but in this case rendered conspicuous by rising abruptly out of a clay flat on one side and the water on the other. They also give some evidence of being remnants of a sill.

The islands in both Lavallée and Africain bays consist of the Cobalt conglomerate. Between the mass of diabase on Quinn's Point and that next to the south, there is a small low lying exposure of arkose in the bottom of the bay. The arkose shows baking and the nearby higher face of diabase shows progressively finer grain from the top down. In general these occurrences of diabase show much finer grain at the water's edge than higher up. These facts bear out the view that these masses are the remnants of a sill. On the other hand the approximate linear arrangement of these occurrences give some suggestion of their being outcrops of a dyke, but beyond this suggestion there are no other arguments in favour of such a view, and a number of facts in direct opposition.

Contact Phenomena: The metamorphism caused by the intrusion has usually been limited to within a very few feet of the contact. The only places showing any general effect are the occurrences of sediments on lots 7-9 of V. N., where the arkose or quartzite has been partly recrystallized and is "spotted." At the south end of VI. N., the eastern margin of the diabase has digested a certain amount of the sediments. Even fifteen or twenty feet from the contact it is seen in thin sections that the diabase contains numerous partly absorbed shreds of the quartzite and arkose. These are found

in all stages from relatively large fragments down to those that run into a mere streak of material separating the felspar crystals. The felspars are relatively more acid than in the normal diabase, and the ferromagnesian minerals are present in very small amounts. Another feature of the diabase at this locality is the presence of irregular masses of calcite an inch or two across and containing or surrounded by pyrite, chalcopyrite, reddish felspar and some quartz. There is no variation in the grain of the rock surrounding these masses, and they are considered to be magmatic segregations of the same type as the aplite veins. Two or three chains to the west of the contact there are numerous blocks of diabase containing veins and evidently derived nearby. The veins are remarkable in being composed of a heavy crust of axinite next to the walls and filled with calcite stained with cobalt bloom. The only other vein of this type found, cuts the Keewatin in the east drift of the main shaft on lot 3 of V. N. This locality around the south end of 7 of VI. N., would well repay considerable further study.

Correlation: The diabase and gabbro belong to the same series of intrusions as those associated with the silver-cobalt ores of the South Lorrain, Cobalt and the various Montreal River districts. Owing to this economic importance the diabase has received a great deal of attention from both miners and geologists. The result has been to show that occurrences of this same type of diabase are extremely abundant throughout that part of Ontario between Lake Temiskaming and the great developments of Keewenawan diabase around Lake Superior. While no detailed petrographic study of the relations of these various diabase occurrences has been made, it is, however, generally accepted that they all belong to the same general intrusion. The reasons for this belief are: the distribution throughout this area of occurrences of one type, which occurrences are similar not only in their broad features but more especially in the details of differentiation; the intrusives are of the same age in so far as being Post-Huronian. An additional point of similarity is the common association of ore deposits, silver-cobalt -copper ores in the Temiskaming districts, copper at Bruce Mines and Michipicoten, silver in the Port Arthur district, and most probably also belonging here,—the nickel-copper ores of Sudbury. Although it might be safe enough to call this the Keewenawan diabase for the Temiskaming district it appears preferable not to do so until the correlation has been more fully established.

The newer diabase is found to be the youngest solid rock in Fabre. Abundant intrusive contacts were found in the Keewatin. For the Huronian fewer actual contacts were seen, but the general evidence of its later age was quite satisfactory.

CLAYS, SANDS AND GRAVELS.

Of the area indicated on the map as "clays, sands and gravels," probably over ninety-five per cent. is occupied by clays. Freshly exposed sections of the surface deposits are rare, but by piecing together fragmentary information from various exposures, a fairly good idea of the conditions may be obtained.

On Young's Creek in Range VII. N., one of the few good sections shows twelve feet of unassorted boulder clay lying on bed-rock, followed by about thirty feet of stratified clay. The bottom layers of clay are about four inches thick, but in about ten feet upwards they have decreased to an average of half an inch. In other localities both thick and thin layers are found, but it may be said that in general the stratification of the clay varies from one half to about one inch. From stream cut banks it is found that the clay reaches a thickness of forty feet. At various points along the rocky ridge crossing lots 8 and 9 of V. N. and V. S., there are abundant local deposits of gravel apparently occupying the minor hollows of the rock surface. Near the west end of lot 32 of III., road ballast has been obtained from a deposit of cross-bedded sandy gravel, which seems to underlie the clay. The top of the hill on lots 25-27 of II., by the lakeshore, is largely occupied by deposits of boulder till. In numerous other places sand and gravel were found on the hill tops, while clay girdled the foot. Observations made in a number of cases, but not sufficiently widespread enough to be confirmatory, go to show that the stratified clay has not been deposited in Fabre at heights greater than 150 feet above Lake Temiskaming.

Summing up the rather insufficient information, the conclusion is reached that the bed-rock, at all levels, is overlain by irregular variable deposits of unassorted till, sand or gravel, on top of which up to a level of about 150 feet above Lake Temiscaming, is a deposit of stratified clay varying in thickness from nothing up to over forty feet. Wells and springs issuing from the clay, fuller mention of which will be made later under "water resources," confirm the presence of a porous stratum beneath the clay.

CORRELATION WITH OTHER DISTRICTS.

Keewatin: The rocks which are grouped as Keewatin correspond in position, in general lithological character, and in their disturbed condition to the Keewatin as defined by the International Committee on nomenclature. The Keewatin rocks of Fabre are closely comparable with those of the South Lorrain, Cobalt and Gowganda districts. In these other districts the various types have not been mapped separately, but appar-

ently in Fabre the coarse-grained varieties are relatively much more abundant. It was found possible to distinguish approximately three-quarters of the total area of Keewatin as either diabase or granodiorite, and by careful work probably most of the remainder could be similarly divided. There are a few relatively small occurrences of other rocks, such as hornblende, greenstone and other schists, and ellipsoidal greenstones. The ellipsoidal greenstones are closely comparable with those of the Vermilion district of Minnesota.

Laurentian: The term Laurentian has been employed in the present report for granitic rocks of the basement complex, but which may possibly be intrusive into some of the sediments of the Fabre series.

Huronian: The term Huronian for Fabre is applied to a group of three sedimentary series separated by unconformities, at least two of which series rest unconformably on the Laurentian. The middle and upper series are the direct lateral extension of the Cobalt and Lorrain series, described by Miller in the Cobalt district and also found to extend westward at least as far as the Gowganda district, and northward nearly to Lake Abitibi. Seemingly on the basis of lithology the Cobalt and Lorrain series have been correlated tentatively by Miller as Lower and Middle Huronian; however, the comparison with either the Sudbury or original Huronian district is not close. The discovery of the Fabre series beneath these other two shows that they are more likely Middle and Upper. There are no striking features in the Fabre series either, to form a basis of correlation. One great difference between the general succession of Fabre and that of the original Huronian area, is the complete lack of limestones in the former.

Fabre Series: In a number of places outside of Fabre Township, occurrences of sediments have been described, with special mention of their greater deformation in comparison to the relatively unaltered Cobalt series. In addition to localities described by others, the writer, during the course of various reconnaissance trips, particularly in the country bordering the Hudson Bay-St. Lawrence divide, to the north and northeast of Fabre, has also observed a considerable number of these occurrences. The relative position of the areas to be described will be seen by reference to Fig. 1, on page 6.

Mention has been made of a granite cutting a greywacke in the township of Laverlochère, which adjoins Fabre on the north. The description is not very clear, but suggests clearly that the greywacke may belong to the Fabre or other series older than the Cobalt series. (*)

(*) Wilson, M. E., Geological Survey of Canada, No. 1064, 1911, p. 20.

In the vicinity of Rabbit and Eagle Rock lakes, near Lake Temagami, there is found a much fractured quartzite associated with greenstones and referred to the Keewatin. (*)

From information in a private report it appears that on the northeast arm of Lake Temagami there is present one, if not two, series of sediments older than the Cobalt series. It is noteworthy that these contain bands of limestone, and in part at least are quite schistose.

In the Porcupine district occur some highly schistose greywacke slates and conglomerate having the same strike and dip as the Keewatin. This is in sharp contrast to the nearest occurrence of the undoubted Cobalt series, which is quite unaltered.**

North of Larder Lake there is a belt of squeezed greywacke, arkose and conglomerate, distinctly older than the Cobalt series, which is also present.

Extending to the east of Lake Opasatica, an area of over two hundred square miles is occupied by metamorphosed quartzites and arkoses for which the name "Pontiac Schists" has been proposed. (***) These are overlain unconformably by the Cobalt series and are intruded by a granite and gneiss.

On Seals Home Lake, farther to the northeast of this last area, and probably its lateral extension, there is a considerable development of hornblende and mica schists associated with an impure banded quartzite. A similar quartzite is found about four miles north of the National Transcontinental Railway crossing over the Harricanaw river, near the outlet of Seals Home lake, and also to the northwest on the Nawapitechin river.

The above descriptions, chiefly of localities in a northerly direction from Fabre, show fairly clearly that there is an important series of sediments older than the Cobalt series, and at least suggests that the Fabre series may attain quite a considerable development.

In a southerly direction it is much more difficult to draw any comparisons, since the horizon marker used above, namely the Cobalt series, does not extend for more than a short distance. However, certain broad parallels can be drawn which indicate a possible correlation. It is found that to the south of Fabre there is a series of extremely metamorphosed sediments, probably outliers of the Grenville series, quite comparable to the Pontiac schists to the north.

Crystalline limestone of the Grenville series has been reported from the east side of Lake Kipawa, about 30 miles to the southeast of Fabre.

Near Mattawa, about 100 miles south of Fabre, there is an area of sedimentary gneisses containing cyanite and such like

(*) Marginal note on Map No. 599, Geological Survey of Canada.

(**)See marginal note on Map of the Porcupine Gold Area, Ontario Bureau of Mines, 1910.

(***)Wilson, M. E., Geological Survey of Canada, Summary Rept. 1909, p. 175.

minerals, and westward along the Mattawa river several occurrences of crystalline limestones.

In the Sudbury district the oldest sediments have been very much metamorphosed, giving rise to secondary minerals, such as staurolite.

The Grenville series, as typically developed in the Bancroft-Haliburton areas, some one hundred and thirty miles south of Mattawa, consists of a very great thickness of limestones, included in which are minor bands of sedimentary gneisses, with the whole series intruded by granite and extremely metamorphosed.

The writer has not visited these various localities just mentioned, but the published descriptions indicate a strong similarity between them, if not some grounds for correlation. They all lie on the margin of the same immense area of granite and gneiss, than which they are older in most, if not all cases. They exhibit in general a much greater degree of metamorphism than the next following sediments, the Cobalt series, wherever the latter is present. The change from dominant limestones on the south to fragmental sediments on the north, appears to be well explained by a gradation such as would obtain on approach to a shore from deep water conditions.

At the present time we have to leave this correlation as a suggestion, but it points out the way for further profitable investigation.

Diabase and Gabbro: It has already been indicated that while these are very probably of Keewenawan age, yet this has not so far been definitely proven.

ECONOMIC GEOLOGY.

The deposits of the metallic minerals of Fabre may be conveniently grouped together according as they are associated with the Keewatin or the newer diabase.

Keewatin Deposits: In common with that of many other districts, the Keewatin of Fabre shows widespread mineralization, and on a number of the more promising occurrences a considerable amount of work has been done. The most abundant mineral is pyrite, with which chalcopyrite, galena and sphalerite are also frequently found, though in lesser amounts.

The Jessie Fraser Copper Mining Company has been prospecting a deposit on lot 8 of VII. N. The chief body is a band of schist about three feet wide, impregnated with pyrite and chalcopyrite. The development work consists of two shafts, 60 and 85 feet deep respectively, with some drifting and crosscutting. This work was done with a small steam and compressed air

plant, but operations have been suspended for some time. A similar deposit along the strike to the east, on lot 9, is opened by a small shaft.

On lot 15 of VII. N., a couple of prospect pits were sunk some twenty-five years ago by Henry Timmins of Mattawa. The ore appparently consisted of a band rich in iron pyrites, in a country rock of granodiorite.

At the Blake prospects on lot 7 of V. S., pyrite with small amounts of chalcopyrite is found in irregular quartz veins, and as an impregnation of the granodiorite.

At the south end of lot 8 of V. S., there is a number of strong veins dipping at high angles and outcropping in a steep face of granodiorite. One of these, opened by an adit for about twenty feet, shows a calcite vein up to eight inches thick, but only having a few spots of chalcopyrite. Another has been opened by two inclined holes, about fifty feet deep, and starting close together. The first hole, sunk on the dip, went down through a series of small lenses of galena and chalcopyrite in a gangue of quartz and calcite. The second, sunk inclined on the strike, near the surface, cuts through a fault with about ten feet throw, but picks up the vein again on the downthrow side. The vein widens from about ten inches near the fault to three and a half feet at the bottom of the hole. The vein minerals consist of quartz, calcite, pyrite and chalcopyrite. This is the most promising prospect seen in the Keewatin.

On lots 25 and 26 of range IV., prospecting has been carried on in the Keewatin diabase by parties associated with Dr. Aubin of Ville-Marie. A pit ten feet deep is sunk on a clean cut lens-shaped mass of pyrite bearing a little chalcopyrite, and having a maximum thickness of two feet. Another pit is on a vertical joint from which start a number of small short horizontal seams, filled with quartz and calcite, bearing pyrite, galena, sphalerite and chalcopyrite. Two other shafts about fifty feet deep have been sunk on veins having very small amounts of sulphides.

Newer Diabase Deposits: As has already been indicated, the newer diabase and gabbro belong to the same general intrusion as that of the Cobalt and neighbouring silver districts, and it was the hopes of finding similar associated silver ores that caused the first rush of prospecting in Fabre. The veins found with the newer diabase contain the same minerals commonly found at Cobalt, but in a different order of importance. Calcite and quartz are by far the most abundant,—frequently almost to the exclusion of the other minerals; pyrite, chalcopyrite and hematite are next most common, with smaltite or some other cobalt-bearing mineral in small but widespread quantities. Free silver has been reported, but it appears to be rare if found at all. Silver may, however, be

found by assaying, and is usually accompanied by a certain amount of gold, in which respect there is a difference from ores of the Cobalt district.

The diabase of the lake shore in the vicinity of Quinn's Point, on lots 35 to 41 of range II., contains numerous veins. On lot 35 on the slope overlooking Lavallée's bay, a shaft twenty feet deep has been sunk on a calcite vein two inches wide traceable for several chains, and showing very abundant cobalt bloom. On the west side of the same hill there are two shafts, one of them fifty feet deep, on an aplite dyke two inches wide showing cobalt and nickel blooms, pyrite and smaltite; the other on a calcite vein also showing pyrite and smaltite, had reached a depth of forty feet when visited. On lot 36 an aplite dyke averaging nearly eighteen inches wide is exposed on the lake shore for about a chain in length. It shows segregations of calcite and carries disseminated pyrite and chalcopyrite. On lot 37 a shaft seventy feet deep has been opened on a calcite vein five inches wide in places and showing small amounts of pyrite, chalcopyrite and smaltite. On lot 41, an adit has been driven for twenty feet on an aplite dyke five inches wide, and various other pits sunk on other smaller veins and dykes.

Most of this work mentioned above has been done by "La Cie Miniere de la Vallee du St. Maurice."

On the lake shore at the end of Fabre wharf, and cutting the diabase, there is a calcite vein ten inches wide in places, but not showing any metallic minerals. Nearby, small veins of quartz and calcite carry small amounts of pyrite and traces of a cobalt mineral.

On the "Mill" claim, lot 44 of range IV., there are very numerous veins cutting the diabase, and a few cutting a Keewatin greenstone. These have a gangue chiefly of calcite, and carry a considerable amount of smaltite. A shaft twenty-seven feet deep has been sunk on a two inch calcite vein. The area of diabase exposed is very small, but on account of the exceedingly abundant small veins, all displaying cobalt bloom, this property has locally been considered very promising.

Lot 3 of range V. N. has been prospected by the "Terra Nova Mines, Ltd." with a well-equipped steam and compressed air plant. The diabase is in contact with the Keewatin, and cobalt bearing veins are found in both rocks. The main shaft in the Keewatin is 110 feet deep with about 100 feet of drifting and cross-cutting at the 100 foot level. The main vein is a shattered zone four or five inches wide, but containing a clean vein in places three inches thick. The filling is calcite, smaltite, hematite, chalcopyrite and fragments of aplite. At the surface, hematite alone was present. Another vein showing no metallic minerals is remarkable in being chiefly composed of the mineral axinite.

In the diabase a shaft has been sunk about eighty feet on two

nearly parallel calcite veins averaging four inches wide. One vein can be traced on the surface for about twelve chains. Only small amounts of sulphides were observed in either. In numerous other smaller veins nearby, the calcite carries abundant hematite, apparently derived from the oxidation of chalcopyrite. Openings have been made on a very large number of small veins and cracks in various parts of the property.

On lot 5, just east of this last property, and also in the Keewatin, prospecting has been carried on by the Pontiac Mining and Milling Co., but operations have been suspended for some time. The dump showed the vein to have carried hematite, magnetite, chalcopyrite, pyrite and galena, but according to the report of Wilson, there does not appear to have been any important or workable concentration of these minerals in the veins. A vein having a similar relation of minerals is also found on lot 3 of V. S., in a pit a short distance south of the main shaft of the Terra Nova property.

CONCLUSIONS.

The fundamental requirement for the successful working of an ore deposit is that there should be a sufficient amount of ore recoverable to pay for the direct and indirect cost of its removal, and yet still leave a margin for profit. The cost of mining the ore is governed by a number of principles, of which we will only discuss the more important.

In working underground it is necessary to have all openings wide enough to give sufficient elbow room to work to advantage, but the width is independent of the width of vein. To illustrate the effect of this, if the minimum working width is fifty inches, and the vein is one inch wide, then the proportion of ore to barren rock will be as one to forty-nine. Supposing, however, the vein is ten inches wide, this proportion will be reduced to ten to forty, or as one to four. Since the work done must be paid for by the value of the ore obtained, it thus follows that a narrow vein is worked under a very heavy handicap. If the veins are short, or pinch and swell suddenly, so that a lot of unprofitable work has to be done in finding or in following the ore bodies, this gives a similar and even additional handicap to that of narrow veins.

The ore, whether produced from wide or narrow veins, must, moreover, contain a sufficient proportion of the desirable mineral to give a certain average value, depending on working costs. A narrow vein of high grade ore may be quite as profitable, or even more so, than a wide vein of low grade ore.

The workability of a deposit is also closely dependent on general conditions, such as transportation facilities, availability of supplies of timber, water, fuel, power,etc.

Applying these considerations to the ore deposits of Fabre, we find that:

(a) The veins are narrow, excepting a few of the Keewatin copper veins; the average width would be under three inches.

(b). With one or two exceptions the veins are short and pinch out quickly.

(c). The vein material, even when obtained, is very largely composed of nearly barren calcite and quartz carrying only small values.

(d). Transportation facilities and availability of supplies are not unfavourable to mining.

(e). So far, prospecting has not discovered any workable bodies of ore.

(f). No ore worth saving has been obtained from the prospecting already done.

(g). Those who have done the most important work in prospecting and are thus in the best position to judge the results, have ceased work.

In view of all these considerations, and after comparison with the working mines of South Lorrain and Cobalt, the conclusion seems unavoidable that there is at present no great promise in the mineral deposits of Fabre.

CLAYS.

The clay which is so well developed in Fabre is quite similar to that already successfully employed in the manufacture of bricks at New Liskeard. Whenever conditions call for its use there is an unlimited supply of clay available in Fabre.

WATER RESOURCES.

Fabre Township is bounded on the west by Lake Temiskaming, into which drain the only two streams in the area of any considerable size—Lavallee and Young Creeks. Since almost all the forest has been removed, the snow and rain waters run off both quickly and completely, with the result that there are very few smaller streams tributary to those just noted, and in consequence, in a large number of cases, the settlers are obliged to get their supplies of water from wells. It is ,therefore, of considerable importance to know what are the underground water resources.

On the shore at Lavallee Bay, north of the point at Fabre wharf, there are a number of natural springs issuing from the bank and giving a strong flow of water.

Along the road running north from Fabre village several persons have obtained abundant flows of water from driven wells, and a couple of wells in the village itself have found smaller supplies.

At the south end of lots 1 to 5 of V. S., there is one good driven well and a number of natural springs. A good natural spring is found on lot 12 of V. N.

In general this water, while rather hard owing to its carrying considerable amounts of lime and iron salts, is quite satisfactory for domestic uses. The water evidently comes from beneath the clay, and the number of natural springs together with the success already obtained by artificial means, indicates that in many places there is an abundant supply of excellent water to be had for the seeking. The small cost at which a well may be driven in the clay makes it worth while to attempt to obtain water, even where there are no specially favourable surface indications.

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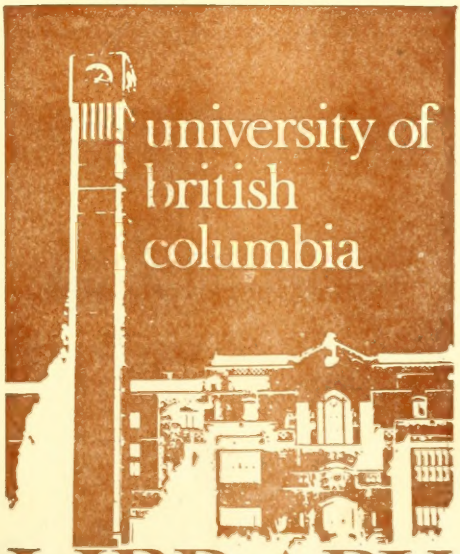

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